Modifications in Hepatic Blood Flow and Portal Pressure Produced by Different Diets

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THERE IS EVIDENCE that some constituents of the diet can alter blood flow and pressure in the region of the portal vein. Hoffbauer *et al.*[1] showed, in dogs with cannulated splenic veins, a sustained rise in portal pressure after a meal containing meat. They observed a simultaneous increase in blood flow through the mesenteric artery which persisted for 4 hr. or more. Brandt *et al.*[2] studied (by catheterization of the hepatic vein) the hemodynamic action of ingestion of proteins in patients with cirrhosis of the liver and in normal controls. They found that the hepatic blood flow increased 33% in normals and 27% in cirrhotics; concomitantly, the O_2 consumption increased 55% in normals and 14% in cirrhotics. Another group had received 100 gm. glucose, with no detectable change in the hepatic flow. Castleman *et al.*[3] found that ingestion of meat is followed by a rise in the portal pressure, as measured through a catheter wedged in the hepatic vein. This rise, however, did not always occur, and was not seen in subjects fed glucose or inert substances of equivalent volume. Administration of intravenous albumin, which causes a significant increase in hepatic blood flow,[4] produced only a minimal increase in portal pressure.[3] On the other hand, observations on the action of glucose administration are contradictory; Mattson[5] found an increase in hepatic flow after intravenous injection of glucose, and similar results were obtained by Wakin,[6] in the frog. Bearn *et al.*[7] have shown that hypoglicemia in man produces an increase in hepatic flow, and this

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has been confirmed by Grayson and Kinnear.[8] This increase in flow disappears when the hepatic artery is ligated, and it has been suggested that the increase in hepatic blood flow after administration of insulin may be due to release of a local vasodilatory substance in the liver.

The effect of protein has been attributed to several mechanisms: a secondary effect of the process of digestion, or the secretion of some substance by the digestive tract,[3] or partially to the specific dynamic action of proteins.[2] It has been shown that the specific dynamic action of proteins is due to energy consumption during the synthesis of urea by the liver.[9] This has been confirmed in human Ss, in whom intravenous administration of amino acids produces a marked increase in splanchnic oxygen consumption and little or no change in hepatic blood flow,[10] in contrast with what happens after intravenous injection of albumin.[4]

Our purpose was to study this problem under less artificial conditions and with the use of diets closer to the S's normal eating habits. It does not seem valid to compare the effect of ingestion of glucose with that of a meat-containing meal, since the former does not require digestion, as the latter does. Furthermore, the effects of diets rich in fat seemed worth studying. It also seemed important to examine the response of hepatic blood flow to the stimulation of ureogenesis produced by administration of ammonium chloride.

To study the estimated hepatic blood flow (EHBF), human albumin tagged with I^{131} and denatured by heat was used. This colloid (particle size, between 10 and 30 $m\mu$) [11] was chosen because it permits determination of the hepatic blood flow with sufficient accuracy and without requiring the sampling of blood through a catheter inserted in the hepatic vein. Colloidal albumin denatured by heat is removed from the blood very efficiently when flowing through the sinusoids of the normal liver; a very small quantity of the colloid is removed in extrahepatic territories.[12]

MATERIALS AND METHODS

Subjects

The Ss for this study were 34 healthy volunteers. In 10 of them, EHBF was measured before and 2 hr. after they had eaten a high protein meal, containing 91 gm. of protein, 8.1 gm. of carbohydrates, and 19 gm. of fat. In 3 of these Ss, the test was repeated, with 10 mg. of the anticholinergic drug tri-dihexethyl chloride (Pathilon*) given intramuscularly immediately after the meal. The effect of Pathilon on EHBF was also studied in 4 fasting Ss.

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